APPENDIX B

DERIVATION OF THE WILSON TABULAR METHOD OF STREAM ROUTING

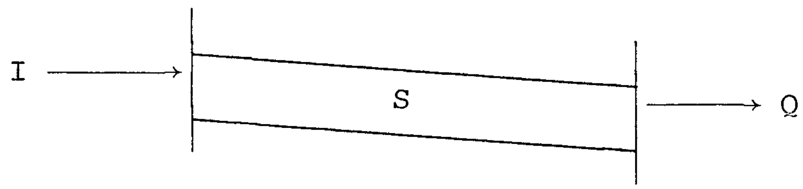
The Wilson tabular method of channel routing uses a linear reservoir for reach storage.

$$S = K_s\ Q$$

S = storage (cu. ft.)
Q = discharge (cu. ft./sec.)
K_s = constant (sec.)

flow function $\dfrac{ds}{dt} = K_s \dfrac{dQ}{dt}$

K_s is a function of the reach length.



Continuity equation:

$$\frac{ds}{dt} = I-Q$$

Combine the two above equations for $\dfrac{ds}{dt}$

$$I-Q = K_s \frac{dQ}{dt}$$

$$\bar{I}-\bar{Q} = K_s \frac{(Q_2 - Q_1)}{\Delta t}$$

$$\frac{I_1 + I_2}{2} - \frac{Q_1 + Q_2}{2} = K_s \frac{(Q_2 - Q_1)}{(\ \Delta t\ )}$$

$$Q_2 + \frac{2K_s\ Q_2}{\Delta t} = I_1 + I_2 - Q_1 + Q_1\ \frac{2K_s}{\Delta t}$$

$$Q_2\ (1 + \frac{2K_s}{\Delta t}) = I_1 + I_2 - Q_1\ (1 - \frac{2K_s}{\Delta t})$$

Let $c = \dfrac{2K_s}{\Delta t}$

$$Q_2 = \frac{I_1 + I_2 + Q_1\ (c-1)}{(c + 1)}$$

K_s is the travel time of the reach.

$$K_s = \frac{S}{Q} = \frac{AL}{AV} = \frac{L}{V} \quad \text{(Uniform flow)}$$

A = cross sectional area.
L = reach length.
V = flow velocity for steady uniform flow.

$$K_s = \frac{L}{V} = T_t = \text{travel time of the reach}$$

Actually we are concerned with the flood wave velocity instead of the flow velocity.

$$T_w = \frac{T_t}{R}$$

T_w is the travel time of the reach based upon the flood wave velocity.

R is the ratio between T_t and T_w
R ranges from 1.2 to 1.5
Typically R = 1.3 to 1.4

therefore $K_s = \frac{T_t}{R} = T_w$

use $\Delta t \leq K_s$ (0.5 K_s to K_s)

To determine T_t use bankful velocity or a maximum expected velocity for a given design frequency